

**TITLE:        APPARATUS AND METHOD FOR VENDING FROM**  
**A VENDING MACHINE**

**BACKGROUND OF THE INVENTION**

**A.    Field of the Invention**

The present invention relates to an apparatus and method for vending vendible products, and in particular, to a methodology and apparatus to attempt to ensure a successful vend every time.

**B.    Problems in the Art**

The art of vending machines has advanced significantly over the years. There has been a proliferation of the number and types of vending machines. Furthermore, there has been a significant increase in the types of products that are vended (e.g. kind, size, shape, weight, value).

One area with need for improvement is ensuring that a selected product is in fact vended to the customer. While this is a desirable goal, it must be implemented in an economical, effective, and efficient way.

There are times when the vending machine is improperly loaded such that there is a gap in products or missing products in the vending machine. The customer may make a selection that results in

1 operation of the machine. However, the gap or missing product does  
2 not result in the selected product being produced to the customer.  
3 Because the machine has operated, it assumes a successful vend was  
4 made. The customer not only does not receive the selected product,  
5 but cannot retrieve the money or token used to initiate the vending  
6 cycle.

7 Similarly, in some instances a vending cycle is properly  
8 initiated but the product gets hung up or does not make it all the  
9 way to a location that is accessible to the customer. For example,  
10 there are times when a vending machine operates a complete vend  
11 cycle (e.g. operates a motor rotating a spiral for 360 degrees of  
12 rotation), but the product is not quite able to fall from the  
13 dispensing mechanism. Again, the machine assumes a successful vend  
14 was made.

15 United States patent application US 2001/0000408 A1, published  
16 April 26, 2001, describes many of the concerns and considerations  
17 with respect to these types of problems. This publication is  
18 incorporated by reference herein in its entirety.

19 There is a need for an improvement in the art relative to this  
20 issue. U.S. patent application US 2001/0000408 A1 discusses such  
21 problems in detail and discloses an attempt at a solution. It uses  
22 an optical detector to attempt to automatically detect whether a  
23 product actually makes it to a customer-accessible location. The

1 vending machine initiates a vend cycle in response to an  
2 appropriate instruction and/or money from the customer. In U.S.  
3 patent application US 2001/0000408 A1, the vending machine has one  
4 or more horizontal trays, each with one or more horizontally  
5 positioned spirals or helixes positioned front to back. Each helix  
6 is operatively connected to an independently operable motor.  
7 Vendible products are loaded between turns of each spiral in what  
8 is referred to as a horizontal column of vendible products.  
9 Operation of a motor causes its associated spiral to turn, which is  
10 intended to cause all products in the column of products loaded in  
11 the spiral to advance toward the front of the spiral. If the  
12 optical sensor of U.S. patent application US 2001/0000408 A1  
13 detects a predetermined variation in intensity, the vending machine  
14 assumes it was caused by a falling selected product, the vend cycle  
15 is assumed complete, the motor is turned off, and the machine waits  
16 for the next selection by a customer. U.S. patent application US  
17 2001/0000408 A1 addresses the problems in the art in a specific  
18 way. When the vend cycle is initiated, a timer is started. The  
19 timer has been pre-set to correspond to rotation of the motor for  
20 that spiral well past one complete rotation. If the sensor detects  
21 nothing over the first 360 degrees of rotation, the motor does not  
22 stop but continues to operate until the timer expires. In U.S.  
23 patent application US 2001/0000408 A1, the timer period is selected

1 to be equivalent to about 540 degrees, or one and one-half  
2 revolutions of the spiral. The theory is that instead of relying  
3 on one motor rotation for one vend cycle, and risking that a  
4 product will not be successfully vended, the motor will be allowed  
5 to operate for well over one rotation to attempt to give  
6 substantial opportunity for at least one product vend to take  
7 place. U.S. patent application US 2001/0000408 A1 avoids using  
8 motors that have internal switches, well known in the art, that  
9 indicate when each 360 degree rotation has occurred, freeing itself  
10 from the cost and assumption that 360 degrees of rotation is the  
11 standard rotation to use for each vend cycle. Instead, it places  
12 reliance upon the optical sensor and an intentional extended time  
13 period of possible motor rotation (substantially over 360 degrees),  
14 to try to ensure that a successful vend is made each time. At  
15 expiration of the predetermined time period, if the optical sensor  
16 has not sensed a vend, the machine stops the motor and assumes  
17 there is a problem with that selection or column of product, and  
18 either refunds credit or prompts the customer to made another  
19 selection. Because of this reliance on the optical sensor,  
20 substantial pre-calibration steps of the sensor are taken prior to  
21 each vend request.

22 Additionally, U.S. patent application US 2001/0000408 A1  
23 describes in detail a variety of steps that are taken to deter

1 malfunction or manipulation of the vending machine. These appear  
2 necessary because of reliance on the optical sensor and use of the  
3 above-described methodology to try to ensure a vend every time.  
4 While this does attempt to solve the above-discussed problems, its  
5 approach can result in the following. If, for example, the sensor  
6 is temporarily or otherwise malfunctioning, and such is not  
7 detected or acted upon by the vending machine, it is possible the  
8 customer did receive a first vend, but then would be given the  
9 windfall of a second vend. Examples are discussed in U.S. patent  
10 application US 2001/0000408 A1, including the possibility that a  
11 product could, in some cases, bypass detection of the sensor, or  
12 the sensor does not accurately assume a vend or lack of a vend.

13 Also, there are times when, at the completion of an  
14 unsuccessful vend cycle (e.g. 540 degrees rotation), the product is  
15 close to being vendible, or is temporarily hung up or stalled from  
16 falling to the detector, or otherwise slightly delayed in reaching  
17 the vend sensors. Again, in U.S. patent application US  
18 2001/0000408 A1, the selected time period (and amount of rotation,  
19 e.g. 540 degrees) may not be enough to obtain a successful vend.  
20 And then, the customer would be denied selection from that column  
21 because it would be disabled until the vending machine operator can  
22 review and remedy the situation.

1        Furthermore, there is no disclosed back-up system for  
2 operation of a column in U.S. patent application US 2001/0000408 A1  
3 if the optical sensor is indicated to be malfunctioning.

4        Also, because the motor is immediately stopped when the  
5 optical sensor indicates a vend in U.S. patent application US  
6 2001/0000408 A1, there is no general uniformity how much angular  
7 rotation of the spiral occurs per vend cycle. Thus, if one product  
8 falls out early in a vend cycle (e.g. with 160 degrees rotation),  
9 the motor stops the spiral at about 160 degrees for the first vend  
10 cycle. If the next-in-line product was loaded or reacts in a  
11 manner that it does not vend over the next 540 degrees spiral  
12 rotation, it might not vend the next-in-line product; even though  
13 the two products might have both vended on two successive 360  
14 degree motor rotations.

15        Also, since the leading end of the spiral "runs out", the  
16 operator may want to doubly make sure that the first few vends will  
17 be successful. It is likely the operator will place the first  
18 product in the column somewhat back away from the leading end of  
19 the spiral, to avoid a problem on the second vend. This can lead  
20 to less products being loaded in the column when the machine is re-  
21 stocked, which is less productive and efficient for the operator.

22        U.S. Patent 6,202,888 B1, issued March 20, 2001, also  
23 incorporated by reference herein, recognizes there can be problems

1 with product hang up and also with product security. Its solution  
2 is to rotate the mechanism that moves the product to a delivery  
3 location at least one, and optionally somewhat past one, complete  
4 rotation (e.g. by timing), to attempt to ensure that the product in  
5 the first position is dispensed. It then reverses rotation back to  
6 a home position (one complete revolution position), or behind home  
7 position to try to ensure the product can not be vibrated loose by  
8 shaking the machine, and awaits the next vend instruction. U.S.  
9 Patent 6,202,888 B1 discusses use of a sensor (e.g. an optical  
10 sensor) to detect a vended product. It also discusses use of a  
11 sensor to detect if a product is present at the front of a helix,  
12 ready to be dispensed. It does disclose the ability to use motor  
13 switches or home position sensors for the motors to tell when a  
14 "home" position for a motor is reached. There is no second vend  
15 cycle to attempt to provide a product if no product is sensed as  
16 vended after the first cycle, however. The vend cycle is preset to  
17 have the motor rotate the helix an angular amount, and then  
18 automatically each time reverse direction an angular amount.

19 Therefore, there is still room for improvement in the art.

1                    **BRIEF SUMMARY OF THE INVENTION**

2            It is therefore a principal object, feature, or advantage of  
3 the present invention to provide an apparatus and method which  
4 improves and/or solves problems and deficiencies in the art.

5            Other objects, features, and advantages of the invention  
6 include a method and apparatus for vending vendible products which:

- 7            a.    works well for a variety of different vendible product  
8                   types, sizes, shapes, weights, and values.  
9            b.    does not rely only on a product sensor, whether optical  
10                   or otherwise;  
11            c.    has alternative operating mode if a product sensor is  
12                   indicated to have or does malfunction;  
13            d.    provides improved probability of successful vends;  
14            e.    does not give a high probability of windfall vends;  
15            f.    can provide information helpful to track vending machine  
16                   performance.  
17            g.    provides good product security after each vending cycle.

18            Other objects, features, and advantages of the present  
19 invention will become more apparent with reference to the  
20 accompanying specification and claims.

21            The present invention relates to an apparatus and method for  
22 increasing the likelihood a successful vend is made for every  
23 authorized customer selection in a vending machine. The vending



1 machine includes a controller, at least one product dispensing  
2 system for receiving a column of vendible product and driven by a  
3 motor with a home position sensor, and a product sensor to detect  
4 if a selected product from the column has been moved out of the  
5 column. The motor and product sensor are in operative connection  
6 to the controller.

7 In one aspect of a method according to the invention, there  
8 first can be an automatic check of the operation of a product  
9 sensor. If the check is negative, the vending machine is  
10 instructed to accomplish vend cycles without use of the product  
11 sensor. In one embodiment, subsequent vend cycles are accomplished  
12 by simply stopping the product dispensation motor after each  
13 rotation, using the home position sensor associated with the motor.

14 On the other hand, if the product sensor test is positive, a  
15 vend cycle is started by operating the appropriate product  
16 dispensation motor for the product selection, causing it to begin  
17 rotation from its home position. If the product sensor detects a  
18 product during that first vend cycle, and before the motor reaches  
19 its home position, the controller reads the product sensor and  
20 recognizes this as a successful vend. The motor also continues to  
21 operate until it reaches its home position. Optionally, the  
22 controller can use the recognition of a successful vend in an

1 accounting regimen to keep track of successful vends for that  
2 customer selection.

3 If the product sensor does not sense a successful vend during  
4 the first vend cycle by the time the motor returns to home  
5 position, the motor is stopped or paused at home position, but the  
6 product sensor and controller continues to monitor for a preset  
7 time period. If a product is sensed by the product sensor during  
8 that period, the controller recognizes a successful vend. The  
9 product dispensation motor was already stopped or disabled and in  
10 its home position, and is ready for a next vend cycle.

11 If no successful vend is sensed during the pause period after  
12 the first vend cycle, a second vend cycle is started by starting  
13 the product dispensation motor again. Optionally, the controller can  
14 keep track of the fact that a second vend has commenced for this  
15 product selection and stored for later use. If a successful vend  
16 is sensed, the motor is stopped immediately, and the controller  
17 reads that the vend has now been successful. The motor is stopped  
18 and left in that rotational position regardless of whether it is in  
19 the home position. It is ready for initiation of a next vend  
20 cycle. When that occurs, the same method would be repeated except  
21 during the first vend cycle, the motor would rotate back to home  
22 position, even if it is only a small angle of rotation, and stop.

1 If, after the pause period, no vend is sensed, the second vend  
2 cycle would begin from that home position.

3 If a product is not sensed by the time the motor reaches the  
4 home position during the second vend cycle, a signal can be created  
5 which can activate an indicator of a malfunction, give the customer  
6 credit, and/or give the customer a prompt to make an alternative  
7 selection. Optionally, the controller can store information  
8 indicating that the vend was unsuccessful, even though a second  
9 vend cycle for the same product selection was completed.

10 Instead of disabling the column from further vending, an  
11 optional feature is to alternatively allow one or more additional  
12 attempts at getting a vend from the column, before disabling it.

#### 13 BRIEF DESCRIPTION OF THE DRAWINGS

14  
15 Figures 1A and 1B are a flow chart of the operation of one  
16 embodiment of a method according to the present invention.

#### 17 DETAILED DESCRIPTION OF THE INVENTION

18  
19 For a better understanding of the invention, one embodiment  
20 thereof will now be described in detail. Frequent reference will  
21 be made to the appended drawing. Reference numbers will be  
22 utilized in the drawing to indicate certain parts and locations in  
23 the drawing.

1       The environment of this example of the invention will be in  
2 conjunction with a vending machine having a housing inside of which  
3 are a plurality of horizontally positioned trays. Across each tray  
4 are a plurality of product dispensing systems, each including an  
5 independently controllable motor, adapted to serially deliver  
6 vendible products to a dispensation location, where each is pushed or  
7 falls off the tray and travels to a location where the customer can  
8 access it.

9       The motor has a home position sensor or switch, such as are  
10 well known in the art. This allows a controller to know when a  
11 motor is or is not in home position.

12       A set or column of vendible products are loadable into a helix  
13 or spiral operatively connected to a motor in preparation for a  
14 vending selection. When loaded, the products are normally in a  
15 series extending from the back of the vending machine to the front.  
16 Upon selection of a certain product in the tray, the appropriate  
17 product dispenser actuator or motor operates to move all items  
18 loaded in the helix forward; and it is intended that the foremost  
19 item be advanced to a location at the front end of the helix and  
20 the front edge of the tray. By gravity or other means, it is  
21 designed that an item at this location fall from the tray, and drop  
22 along a path to a customer-accessible location.

1       An optical sensor is placed along this path prior to the  
2 customer-accessible location. This optical sensor is designed to  
3 sense if a product or other object falls or moves past it.

4       U.S. Patent 6,202,888 B1 or published application U.S.  
5 2001/0000408 A1, disclose several types of vending machines and  
6 sensors of these general types. They disclose different types of  
7 optical sensors for attempting to determine if a product has been  
8 vended. There are a number of different types of dispensing  
9 mechanisms and product vend sensors which could be used.

10       In this embodiment, the optical sensor is an infrared  
11 emitter/collector set where the emitters are positioned on one side  
12 of the product drop path, and the collectors on the other. An  
13 example of an optical sensor that can be used is Model VNDA3  
14 available from TAL, Inc. of Rishon le Zion, Israel. An output  
15 signal of 5V indicates the beam is blocked and a ground signal  
16 indicated an open optical beam. The output signal from the sensor  
17 is set at a pin of an interface which is connected to 5 volts  
18 through an 11 K Ohm pull-up resistor. Total current draw of the  
19 optical sensor should not exceed 50 ma. A change of state of the  
20 sensor's output signal should remain constant for 3 msec for proper  
21 detection by the controller. Other sensors and reading  
22 arrangements are of course possible.

1 In this embodiment, the motor has a home position sensor. The  
2 motor is configured so that one rotation of the motor and its  
3 associated spiral "home" to "home" (usually about 360 degrees) One  
4 rotation is usually sufficient to move one product in the column  
5 sufficiently to be dispensed. Also, it is generally the best way  
6 to keep products secure from unauthorized vending by shaking the  
7 vending machine. Each motor rotation therefore is intended to move  
8 succeeding products to dispensation.

9 The motor can be a model 0333, from Merkle-Korff Industries of  
10 Des Plaines, IL, and include internal sensing switches sensing when  
11 the motor has rotated one revolution. This allows a mechanical or  
12 electro-mechanical sensing of motor home position, and allows the  
13 controller to start and stop the motor when "home" position is  
14 sensed. These types of sensors are usually durable and accurate.  
15 Each authorized product selection normally results in the motor  
16 rotating from home position to home position and stopping until the  
17 next product selection.

18 An example of a controller that can be used is Model 407990  
19 available from Coinco Coin Acceptors of St. Louis, MO. Such a  
20 controller supports a variety of functions and a variety of  
21 peripheral devices. Examples are a ten digit vacuum fluorescent  
22 display (VFD), a 3 x 7 matrix keypad, and up to 120 DC motor

1 drives. The controller also can support a coin mechanism, optional  
2 bill acceptor, and a card reader.

3 Power is supplied via a 50/60 Hz transformer with secondary  
4 leads supplying 22 VAC to 32 VAC at 3.0 amps. A nineteen position  
5 header provides motor drive capability for up to 120 motors (each  
6 rated at 24 VDC, 100 mA nominal), arranged in a 12 x 10 matrix.  
7 Motor current is limited to under 500 mA.

8 An international Multi-Drop Bus Interface has a six-position  
9 header for connection to peripherals. Protocol will be in  
10 compliance with NAMA's "International Multi-Drop Bus Interface  
11 Standard (Aug. 19, 1994 Revision).

12 Satellite devices can also be controlled via an Universal  
13 Satellite Device (USD) interface. A handheld computer (DEX/UCS  
14 style) compliant with NAMA "The Vending Industry Data Transfer  
15 Standard", dated Jan. 2, 1992, can be used to program and access  
16 (download) vend information from the controller.

17 The types of vending machines, vending machine trays or  
18 organization and structure, motor rotational position sensors,  
19 product dispensation mechanisms, and product vend sensors can vary  
20 and the invention is not limited to any such specific items. These  
21 components are well known in the art and available commercially.  
22 An example is found in U.S. patent application US 2001/0000408 A1.

1 Therefore, further details about the specifics of these components  
2 and their operation and functions will not be given here.

3 By referring to Figures 1A and 1B, a method for trying to  
4 ensure successful product dispensation for each customer selection,  
5 according to an embodiment of the present invention, is shown and  
6 will now be described in detail.

7 As indicated above, the controller can control a plurality of  
8 motors (up to 120). However, for simplicity, this method of  
9 Figures 1A and 1B is described relative to one motor/spiral  
10 combination for a product selection from a tray of a vending  
11 machine. However, as is obvious, the same method can be applied to  
12 any motor selected in the vending machine. It is to be understood,  
13 however, that it is common that sets of motors are selected to  
14 operate in similar modes, as opposed to individually setting up  
15 operation of each motor. For example, it is common to allow all  
16 motors on one tray to work in the same way. However, individual  
17 selection of operation mode of each motor is possible

18 The infrared emitter and detector of the optical sensor are  
19 spaced apart on opposite sides of a product delivery path to form a  
20 product vend optical sensor. The optical sensor is in operative  
21 communication with the electronic controller for the vending  
22 machine, such as identified above and are well known in the art.



1       As indicated at Step 12 in Figure 1, the operator of the  
2 vending machine can designate whether product selection(s) will be  
3 monitored by the optical sensor. This is accomplished by  
4 programming or setting the system to recognize that the particular  
5 product selection(s) is enabled for optical sensing.

6       When a customer selects an item from the product selection  
7 here being discussed (Step 14), confirmation of an authorized  
8 product selection (for example confirmation of an appropriate  
9 amount of money) is communicated to the controller. A timer is  
10 started (Step 16 — here, e.g., 5 milliseconds in length). The  
11 controller tests the optical sensor (Step 18) to see if it appears  
12 to be operational. If the test does not result in a positive  
13 signal (and thus indicating some malfunction or blockage of the  
14 sensor), the controller converts the operation of this product  
15 dispenser to a non-optical sense mode. In this embodiment, the  
16 vending machine defaults to simply having each vend cycle  
17 determined by beginning at a home position and ending at a home  
18 position, using the motor home position sensors for each motor.  
19 The optical sensor is not considered.

20       For example, if the infrared emitter or receiver is blocked by  
21 debris or otherwise inoperable, the controller senses a problem  
22 with the optical sensor. What is called the normal home switch-  
23 vend cycle is then used. Also, the blockage can be noted in the

1 service mode diagnostics submenu and will indicate the error for  
2 the operator.

3 In the normal home switch-vend cycle mode of operation, upon  
4 authorized selection of an item (Step 14), the motor will be  
5 instructed to leave home position. Once its return to home  
6 position is sensed, the motor will be stopped in home position and  
7 the controller will be signaled that a successful vend has been  
8 accomplished, regardless of whether one in fact has or has not.  
9 (Steps 22, 24, and 26). Additionally, if available, an accounting  
10 program will be updated to add that a successful vend has occurred  
11 (step 28), again, not knowing whether one in fact has. Note that  
12 if the controller does not read that the motor has returned to home  
13 after a pre-selected time period (e.g. 5 to 8 sec.), the  
14 controller will assume malfunction (e.g. of motor or motor home  
15 sensor or electrical connections to same) and will (see step 23) go  
16 to step 60, where controller will generate an alarm or indicator to  
17 alert the customer and/or an error flag can be stored in the  
18 controller for the operator. Also, if at any time the controller  
19 senses current loss or a circuit break at or to the motor, it can  
20 disable electric power and go to step 60.

21 On the other hand, if after the 5 millisecond optical sensor  
22 test period there is no indication that the optical sensor is  
23 blocked (Step 30), the controller will initiate operation of the

1 motor by sending it out of home position, commencing a vend cycle  
2 one (Step 32). The optical sensor will be enabled (Step 34). If  
3 the optical sensor "senses" a product during that vend cycle one,  
4 the controller will allow the motor to return to home position  
5 (Steps 36 and 24) and then assume a successful vend (Step 26) to  
6 the controller. The motor is thus in home position, ready for a  
7 next vend cycle for a next authorized production selection for that  
8 motor (Step 28,12).

9 However, if there is no product vend sensed by the optical  
10 sensor during vend cycle one, the motor will be allowed to return  
11 to home position and will be stopped or paused there (Steps 38 and  
12 40) for a preprogrammed time period. At this time, a timer will be  
13 started (Step 42 - e.g., for one second in length) and the optical  
14 sensor will be enabled. The controller will continue to monitor  
15 the sensor for product delivery. If the sensor during this pause  
16 period does indicate a product vend, the controller will be  
17 signaled (Step 26) and assumes a successful vend. Current is shut  
18 off to the motor. The motor is in home position and thus ready for  
19 the next vend cycle (steps 28, 12).

20 As previously discussed, this short waiting period after  
21 completion of vend cycle one allows a product that has been hung up  
22 or stalled a chance to be detected, and if so, allows the vending  
23 machine to accurately account for a successful vend. The waiting

1 period can be adjusted by appropriate programming of the  
2 controller.

3 If a product is still not sensed as vended after this "pause"  
4 period of time (Step 46), the controller initiates a second vend  
5 cycle (vend cycle 2) (Step 50). Optionally, a signal can be sent  
6 to the controller logging in that a second vend is now occurring  
7 because no successful vend was sensed for the first vend cycle  
8 (Step 52). This would allow the accounting program to keep track  
9 of unsuccessful first vend cycles and/or number of second vend  
10 cycles initiated. This information can be advantageously used by  
11 the operator to indicate mistakes or sloppy vending machine  
12 loading, or other problems that can be attempted to be corrected.  
13 It also can give better intelligence with regard to the actual  
14 amount of inventory that has been dispensed from the machine  
15 relative to the amount of requests or selections by customers. The  
16 number of second vend cycle operations for a given vending machine  
17 can be stored separately from data on the number of first vend  
18 cycles. This can give an indication of how many second vend cycles  
19 are occurring and can be used in evaluating circumstances relative  
20 to the machine, its loading, its performance, etc.

21 If vend cycle two is commenced, the optical sensor is enabled  
22 and watches for a product during vend cycle 2 (Step 54). It is  
23 important to note that in this embodiment, if a product is sensed

1 during vend cycle two, the controller will immediately stop the  
2 motor (Step 56). This will occur even if the motor is not in home  
3 position. One advantage of doing so is to reduce the possibility  
4 that more than one product will be vended to the customer.

5 For example, it might be that the product from the first vend  
6 cycle gets hung up or not quite pushed off of the tray even though  
7 the motor comes back to home position at the end of the first vend  
8 cycle. If the product does not drop during Step 44, the second  
9 vend cycle is initiated. It might take only a fraction of a turn  
10 of the motor to complete the movement of that product from the tray  
11 and a successful vend. If the motor is stopped immediately, it  
12 should not move far enough to dispense a second product as a  
13 windfall to the customer. And likewise, the next product will be  
14 ready for dispensation and the next customer will less likely get two  
15 products, one authorized and one a windfall. This is because the  
16 process of Figure 1 repeats starting at step 12 or 14 with a first  
17 vend cycle when the next customer makes a product selection; with  
18 a difference being the motor will begin operation of this new first  
19 vend cycle from its non-home position back and run until back to  
20 home, only a part of a revolution. If a second vend cycle is  
21 needed, the motor will then be at home, and be allowed to go "home"  
22 to "home" accordingly.

1        This option allows the vending machine operator to  
2        purposefully mis-time a selection spiral to protect against  
3        "windfall" vends. For example, thin products must have spirals  
4        timed to successfully push product from the tray, but this timing  
5        often makes it easier for windfall shaking of the next product  
6        after rotation.

7        Note though, that if the next customer does not get a product  
8        during the first vend cycle, the system will follow the same  
9        protocol as explained before. It will pause to see if a product is  
10       sensed, and then go to the second vend cycle; again providing the  
11       second customer with the same higher likelihood that he/she will  
12       get a product for his/her selection. After the motor is stopped  
13       during the vend cycle two; a signal can be sent to the controller  
14       to indicate a successful vend. The motor will wait for the next  
15       authorized selection and will return to home position. As stated,  
16       if a successful vend is not sensed, the process will wait (Step 44)  
17       and then initiate a second vend cycle.

18       As can be seen at step 58, however, if after the second vend  
19       cycle is completed, the motor again reaches home position without  
20       the sensor sensing a successful vend, at this point a signal can be  
21       sent to indicate an unsuccessful vend and/or some indicator can be  
22       activated to let the customer know to make an alternative selection  
23       (Step 60). The controller will still assume a successful vend has

1 not occurred and leave intact the credit approved at the beginning  
2 of the process for the customer. The customer can select an  
3 appropriate alternative selection and the controller will then  
4 attempt to vend that. The controller will consider a particular  
5 selection to be empty or sold out. Data is generated and stored in  
6 the controller to indicate to the vending machine operator a  
7 failure has occurred and that the motor and column should be  
8 inspected. This can be done in the form of a flag or error message  
9 (e.g. "motor A1 failed"). This forces the vending machine operator  
10 to fix the motor and/or do a test vend before allowing that column  
11 to be enabled again.

12 The particular column can be disabled from further vending  
13 attempts in the above situation. Other examples include if the  
14 controller senses that the motor is disconnected to power or to the  
15 controller, or a home position or on-off switch has failed, or  
16 there is a short in the motor. In any of these types of cases, the  
17 controller can generate a "make another selection" to the customer  
18 and/or give an audible or other type of alarm, and restore credit  
19 to the customer.

20 In step 59, a timer intervenes if, during the second vend  
21 cycle, there is a motor failure (e.g. open circuit sensed to the  
22 motor or a time-out failure). After a pre-set time period, if such

1 motor failure is sensed, the controller would turn the motor off  
2 and go to step 60.

3       It has been found that in the second vend cycle, it is  
4 preferred to stop the motor immediately upon the sensing of a  
5 product by the optical sensor. While, like the first vend cycle,  
6 the controller could read that a successful vend has finally  
7 occurred and allow the motor to continue back to home position, it  
8 is particularly not preferred to do so when the products being  
9 vended are higher value items (e.g. phone cards, cigarettes). The  
10 risk that a second product will be ejected from the spiral if the  
11 motor is brought back to home in the second vend cycle is to be  
12 avoided. While it might be decided in some circumstances that a  
13 complete home to home should be allowed in the second vend cycle,  
14 to increase the probability that the customer will get a selected  
15 product, this is usually outweighed by the desire to disallow a  
16 second windfall vend. Another reason for this preference is the  
17 case of cigarettes, where the vending machine operator is  
18 responsible for sales or tobacco tax for each vended cigarette pack  
19 or carton. Records must be quite accurate. Windfall vends,  
20 especially undetected, while advantageous to the customer are  
21 problematic for the vending machine operator.

22       An optional alternative to stopping further attempts at  
23 vending from a column where an unsuccessful vend occurred is



1 possible. In an "auto-reinstatement" mode, programmable into the  
2 controller, even if an authorized selection is made and the first  
3 and second vend cycles do not result in the optical sensor  
4 signaling a successful vend, the controller can override or delete  
5 the error flag. This allows the customer, if he/she wants, to  
6 again try to select a product from that column. This feature is  
7 particularly useful for glass front vending machines, where the  
8 customer can see the product in the machine. If a vend is  
9 unsuccessful, the customer may see the desired product is in the  
10 front of the helix and probably now ready to vend. Auto-  
11 reinstatement allows the customer this option, rather than simply  
12 shutting down that column. Auto-reinstatement might avoid  
13 dissatisfaction of the customer.

14        Optionally, a short pause (e.g. 1 sec.) (like the previously  
15 described pause after vend cycle one) could also occur after vend  
16 cycle two to see if any product has been delayed.

17        The above-described exemplary embodiment is but one form the  
18 invention can take. Variations obvious to one skilled in the art  
19 will be included within the invention.

20        For example, default normal home switch-vend cycle (Step 20)  
21 does not need to be utilized. Pre-checking of the optical sensor  
22 (Step 18) or the momentary delay or pause of Step 44 do not have to  
23 be utilized.

1       It should be understood that one possible option is to program  
2 the motor to stop at an angular position away from home position.  
3 For example, the motor could be programmed to stop before it gets  
4 to the traditional "home" position for security reasons. By  
5 stopping short of home position, it is more likely that the next-  
6 in-line product will be farther away from the edge of the tray.  
7 Thus, if someone tries to shake or tilt the vending machine to get  
8 product to drop, it will be less likely to succeed. But the method  
9 of the invention will better ensure that an authorized selection of  
10 a product will succeed.

11       The methodology can be implemented in software such as is  
12 within the skill of those skilled in the art.